clusion that a sense of the beautiful and an admiration for the forms and colours of nature is only a strongly developed instinct inherited from the lower animals! An uneasy feeling is raised not only that the rebuke administered to "man, the most conceited creature," by the flea in Gay's fable is well deserved, but that the description there given of the views taken by other members of creation are far more probable and even reasonable than ever their author thought.

It would very much help the less scientific public to accept the doctrine of development if by it any imaginable explanation of the part an insect takes in its own metamorphosis, or its feelings of personal identity through the states of grub, chrysalis, and butterfly, could be suggested; but an attempt explaining so little as chapter xv. must only make the incredulous close the book more sceptical still.

W. O.

An Elementary Course of Practical Physics. By A. M. Worthington, M.A., F.R.A.S., Assistant Master at Clifton College. 51 pp. (London: Rivingtons, 1881.)

THIS extremely useful and carefully prepared little book is intended to form the basis of the practical teaching of physics for schoolboys. It describes the way of performing fifty-eight experiments in elementary physical measurements. It appears therefore to have exactly struck the right line between the Scylla and the Charybdis of practical physics, in which a middle course between "merely qualitative work only leading to play" and "measurements by costly instruments requiring on an average two hours for each experiment," appears to be difficult to steer. Mr. Worthington, whose experience in teaching of this kind is considerable, has embodied the results of his labours in the present compendious little volume, and were the course he has sketched out adopted in all our public schools the gain to physical science would be great. There can be no doubt that one great drawback to the progress of students in physical laboratories even at the Universities is the want of acquaintance with the common instruments and with the principles of exact measurement. Mr. Worthington's course cannot fail to give this, and to teach moreover something of manipulation, exact observation, and of use of algebra and geometry as applied to real quantities. The acquiring of intelligent and orderly methods of recording observations is facilitated wherever possible by providing a blank schedule or form wherein to enter the various observations and their several corrections, and for comparison between the observed and computed results. The course comprises experiments in elementary mechanical measurements, centre of gravity, specific gravity, elasticity of cords, law of pendulum, &c., and also includes experiments upon the law of Boyle and upon the laws of expansion by heat and of specific heat. We trust it will not be long before Mr. Worthington adds a course of practical experiments in other branches of physics to the present series. He deserves the thanks of all who have to teach physics in the laboratory to beginners in manipulation.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

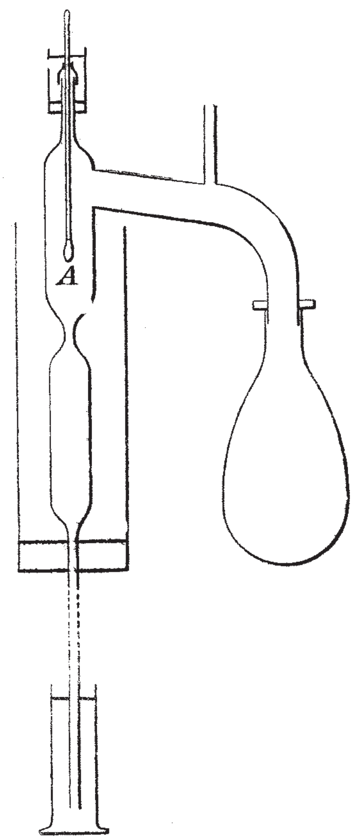
[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Hot Ice

As my name has been mentioned in NATURE in connection with Dr. Carnelley's experiments on hot ice it may possibly be convenient if I describe the experiments in which I have failed to raise the temperature of ice and camphor above their fusing-points when they are heated *in vacuo*.

On December 16, I was present at the meeting of the Chemical Society, when Dr. Carnelley showed his experiments with ice, camphor, and mercuric chloride. At the time they did not appear conclusive to me, for it seemed (although in this I am possibly mistaken) that the thermometer bulbs were too close to the sides of the containing tubes, and that they consequently did not indicate the temperatures of the solids.

A few days afterwards I tried an experiment with camphor in an apparatus so arranged that the thermometer was held rigidly in the axis of a glass tube with the bulb in the middle of a block of camphor which had been previously melted in the tube. The apparatus was exhausted by a water air-pump, and the tube containing the camphor heated. No fusion took place, and the camphor volatilised rapidly; but the thermometer did not indicate a temperature as high as 157° C. The exact temperature could not be ascertained, for a part of the thermometer stem was hidden by the caoutchouc which connected it to the tube. The



fusing point of the camphor being 176°, it is certain that the temperature was far below this, although the glass tube was softened and there were indications of decomposition of the camphor vapour by contact with the hot glass.

Air was afterwards admitted, the camphor fused down, and the air exhausted until the liquid just solidified. Heat was then rapidly applied, but the temperature remained between 170°·2 and 172° until a portion of the thermometer bulb was exposed, when the temperature began to rise. Dr. Carnelley has since informed me that he has obtained precisely similar results with camphor.

On December 30 an experiment was tried with ice in an apparatus bearing a remarkable resemblance to one recently described by Prof. Lothar Meyer (*Ber. Deut. Chem. Ges.* xiv. 718, April 11). The tube A is surmounted by a narrower tube, in which the thermometer stem was fixed by a piece of caoutchouc tube, the joint being surrounded by a tube containing mercury. To the side of A a tube about half an inch in diameter, connected with a copper flask of half a litre capacity, is joined, a branch from this wide tube leading to a Sprengel pump. The

tube A is narrowed in the middle, and its lower extremity terminates in a narrow tube about 33 inches long, and dipping into a cylinder of mercury. Some boiled water was introduced into A before the thermometer was attached, and a small quantity of water was placed in the copper flask. The air was then removed by the Sprengel, the exhaustion being facilitated by heating the copper flask. The water in the glass tube was also heated, in order to expel the dissolved air. When the exhaustion had been completed, the cylinder of mercury was raised until the mercury in the tube stood at the narrow part of A, and the cylinder surrounding the tube was filled with a freezing mixture of ice and salt, the copper flask being also placed in a similar mixture. When the water in the glass tube was solidified, the freezing mixture was removed from the cylinder, the latter lowered, and the column of mercury was depressed by lowering the cylinder of mercury until the column stood at the bottom of A.

A small gas flame was employed to warm the part of the tube containing the ice; some of the ice at the lower part of the solid plug melted and ran down to the surface of the mercury; the upper portion of the ice could not be fused in consequence of the diminished pressure on its surface. When the ice was completely detached from the glass tube a fresh quantity of freezing mixture was placed in the cylinder surrounding the lower part of A.

The air of the room was at 15° C., and the thermometer in the ice indicated – 8°. The tube A was now heated by a Bunsen burner, and the temperature shown by the thermometer was – 6°·5. A jet of steam from a test-tube with cork and narrow tube was directed against the side of A until the ice became very thin on one side of the thermometer bulb; the temperature was now – 1°. The freezing mixture surrounding the copper flask was nearly exhausted; it was therefore replaced by fresh ice and salt, and the steam once more directed against the tube. The thermometer now read – 5°·2. When a small part of the thermometer bulb was free from ice the jet of steam was stopped, and a new freezing mixture placed round the flask, the thermometer indicating – 6°·7. When about one-third of the bulb was exposed the tube was heated by a Bunsen flame and the temperature rose to + 4°, and on allowing the tube to cool it fell to – 5°. Finally, when only a very narrow strip of ice remained attached to one side of the bulb, the tube was strongly heated, and the temperature rose to + 12°, but on cooling it sank to – 2°·2.

The experiment was repeated on January 6, a jacket being placed round the tube so that the heating by steam was more regular than before. On first separating the ice from the containing tube the thermometer indicated – 8°. On heating with a Bunsen it rose to – 6°. When the tube was cold the temperature was – 14°. After passing a current of steam round the tube for half an hour the temperature was – 11°. A fresh freezing mixture was now used, and the steam again turned on; after twenty minutes a small portion of the thermometer bulb became exposed, and two minutes later the temperature was – 9°. A fresh freezing mixture was put round the flask, and when the outside of the tube was cold, the thermometer showed a temperature of – 16°. Steam was again turned on for fifteen minutes, when the temperature was – 12°. When the bulb was half exposed the steam jacket was removed, and the tube heated by a Bunsen; the temperature then rose to – 1°·5. On allowing it to cool it fell again to – 12°. When about three-quarters of the bulb was free from ice the tube was again heated by the gas flame, and the temperature rose to + 29°. The ice then fell off, and although the heating was discontinued the thermometer rose rapidly to 70°.

These experiments, as far as they go, are therefore in accordance with those of Mr. Hannay and Prof. Lothar Meyer, there being no considerable rise of temperature until either the condensation of the aqueous vapour was too slow and the vacuum thus deteriorated, or the thermometer bulb was partly uncovered, and so exposed to direct radiation from the walls of the outside tube.

Two experiments were tried with mercuric chloride, but the results were not satisfactory, in consequence of the high melting point of the solid. The temperature seemed to be above the fusing point, but it was found that the mercury in the thermometer stem had separated. HERBERT MCLEOD

Cooper's Hill, May 3

Sound of the Aurora

UNDER the above heading Mr. Ogle, in last week's NATURE (vol. xxiv. p. 5), gives an extract from the Visitors' Book at the Æggischorn Hotel describing certain electrical effects which were experienced by Mr. and Mrs. Spence Watson, Mr. Sowerby, and myself on July 10, 1863. I would add one or two facts with regard to our position and experiences. We reached the top of the Jungfrau Joch at 10.5 a.m., and were met by a violent hailstorm, which came rolling up from the northern side of the Col. We at once started to return, and had been walking for two hours down the centre of the Aletsch glacier when the electrical effects began to be felt; we reached the Mërjelen See at 3.15, so that at the time of the occurrence we had reached the lower part of the *névé* which is farthest from surrounding mountain tops, where the glacier is widest. We were enveloped in cloud, above which there were no doubt other clouds charged with electricity, and as they approached we were gradually being charged more and more strongly by induction from the lower cloud, and when the discharges or thunder occurred we were suddenly relieved by an electric shock. A kind of *brush discharge* of gradually increasing intensity went on for some minutes, followed by a sudden shock, and this process of bringing us up to the right state of excitement, to be relieved by a sudden shock, was repeated over and over again several times.

The hissing sounds were first heard in the alpenstocks, and gradually increased in loudness up to the sudden discharge. There were clear indications that as condensers of electricity we were not all of the same capacity. We were roped together in threes: in one set of three I was in the middle, with a guide in front and Mr. Sowerby behind. Whilst the charging was going on I felt the pricking sensation at the waist on the side where the cord was knotted, showing that those who were more influenced by electrical induction were charging the others through the rope which acted as a conductor. Judging by his actions, our guide (a young and active man) was strongly influenced by the charge, whilst Mr. Sowerby, the most staid and venerable of the party, was certainly influenced the least. In the other set of three the elderly J. M. Claret of Chamouni was least affected, whereas Mr. Watson, who was not the youngest of the party, was the most powerfully affected. These facts point to a direct relation between the temperament of the individual and his capacity for being excited electrically or his inductive capacity.

I should add that Mr. Packe has had similar experiences, but apparently to a less extent, in his walks in the Pyrenees.

W. GRYLLS ADAMS

Wheatstone Laboratory, King's College, May 9

Palæolithic Man

IN my communication to NATURE, vol. xxiii. p. 604, I chiefly restricted my notes to the higher gravels on the north side of the Thames in and near London. With your permission I will now briefly refer to some of the implementiferous gravels south of London, especially in Kent.

The best known of these are to be seen between the Reculvers and Herne Bay, where a thin stratum of implementiferous gravel caps the cliffs. Similar but deeper gravels, also bearing implements, occurs elsewhere inland, as at and near Chislet. At Canterbury a great number of implements have been found, and to these gravels and implements I would now direct attention. As a rule the Reculver instruments are sharp, unstained, and unabraded (such as have been rolled in the sea of course excepted); the Canterbury examples where the gravel is deep are found at various depths, from 9 feet to 20 feet.

Now there are two distinct classes of implements found in the Canterbury pits, the levels being, according to Dr. Evans, about 80 feet or 100 feet above the river: in one class the specimens are well made and almost as sharp and unstained as when first turned from the maker's hands, in the other the implements are much more rudely made, deeply stained all over of a dark ochreous brown colour, and abraded in a high degree. These latter implements come from distinct strata or deposits of ochreous brown rolled stones that appear to have been brought from a long distance. In my own collection of twenty-nine examples from Canterbury one half are sharp and bright, the other half greatly rolled and deep brown in colour. To my mind these two classes of instruments represent two totally distinct periods in the Palæolithic age immensely removed in time from each other, the abraded examples being the oldest. A point of importance to be observed in the deeply ochreous implements is that many of them were slightly splintered or broken when they were deposited in the Canterbury drift; now these broken and